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206. Proposed by W. J. GREENSTREET, A. M., Editor of The Mathematical Gazette, Stroud, England.

$ABCD$ is circumscribed by a circle center O , and it circumscribes a circle radius r . The perpendiculars from C on the sides are x, y, z, u . Show that $\frac{1}{2}AC \cdot BD = r \sum x$.

Solution by G. B. M. ZERR, A. M., Ph. D., Parsons, W. Va.

The problem should read "the perpendiculars from O " instead of "the perpendiculars from C ."

Let a, b, c, d denote the sides AB, BC, CD, DA , respectively; x the perpendicular on a ; y , on b ; z , on c ; u , on d ; R —circum-radius.

Then $x = \sqrt{(R^2 - \frac{1}{4}a^2)}$. Now $R = AC/2\sin B$.

$$AC^2 = a^2 + b^2 - 2ab\cos B = c^2 + d^2 + 2cd\cos B.$$

$$\therefore x = \frac{1}{2\sin B} \sqrt{(AC^2 - a^2 \sin^2 B)} = \frac{b - a\cos B}{2\sin B}, \quad y = \frac{a - b\cos B}{2\sin B},$$

$$z = \frac{d + c\cos B}{2\sin B}, \quad u = \frac{c + d\cos B}{2\sin B}. \quad \therefore r \sum x = \frac{r(a+b+c+d) - r(a+b-c-d)\cos B}{2\sin B},$$

$$r = \frac{2\sqrt{(abcd)}}{a+b+c+d}, \quad a+c=b+d, \quad \cos B = \frac{a^2+b^2-c^2-d^2}{2(ab+cd)}.$$

$$\therefore \cos B = \frac{(a-c)(a+c) + (b-d)(b-d)}{2(ab+cd)} = \frac{(a+c)(a+b-c-d)}{2(ab+cd)}.$$

$$\therefore r \sum x = \frac{\sqrt{(abcd)}}{\sin B} - \frac{\sqrt{(abcd)} \cdot (a+b-c-d)^2}{4(ab+cd)\sin B}, \quad \sin B = \frac{2\sqrt{(abcd)}}{ab+cd},$$

$$4(ab+cd)\sin B = 8\sqrt{(abcd)}.$$

$$\therefore r \sum x = \frac{ab+cd}{2} - \frac{(a+b-c-d)^2}{8}. \quad \text{But } d=a+c-d.$$

$$\therefore r \sum x = \frac{ab+c(a+c-b)}{2} - \frac{(b-c)^2}{2} = \frac{ab+ac+bc-b^2}{2}$$

$$= \frac{ac+b(a+c)-b^2}{2} = \frac{ac+bd}{2} = \frac{1}{2}AC \cdot BD.$$

207. Proposed by W. W. HART, University High School, Chicago, Ill.

According to Gauss the circumference of a circle can be divided into n equal parts by ruler and compass only, when n is a prime of the form $2^{2^p} + 1$.

The following construction gives good partial results for n equals any integer. If AB is the diameter of the circle, and C is the vertex of the equilateral triangle ABC , and if D is a point on AB at the distance $2AB/n$ from A , then draw the line CD cutting the circle at E and F ; E being the more remote from